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The Effectiveness of Value Based Science Teaching on Affective and Cognitive Domain of Students at Secondary Level

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Abstract

This study investigates the efficacy of value-based science instruction on the affective and cognitive domains of secondary-level students. Quantitative analysis was conducted to attain this purpose. The study was conducted in the Doiwala block of Dehradun district. On the basis of similarities on various parameters, control and experimental groups were made from students of ninth grade for the treatment, using purposive and random sampling and total 150 students were chosen as sample for experimentation and data gathering. Initially, pre-scores for both cognitive and affective domains were recorded. Lesson plans were developed for both conventional and value-based teaching. The experimental group received value-based teaching, while the control group was taught using traditional methods for certain chapters. Following the teaching session, a post-test was administered to assess cognitive and affective outcomes. Using quantitative data on affective and cognitive dimensions, both groups were compared by ANCOVA, incorporating pre-test scores of cognitive and affective accomplishment, verbal intelligence, and socio-emotional school climate as covariates. Data analysis indicated that value-based scientific teaching significantly impacts students' cognitive and affective abilities.

Keywords : value-based science teaching, cognitive achievement, affective achievement, SESS, SESCI, VIT

Introduction

At present, existence of human being is suffering from a crisis. Global wars and conflicts misused scientific and technological applications and disregarded human welfare. Resources are exploited without knowing their effects on natural and social environment which seems unfair from humanistic pint of view. At present, an emphasis is given to mechanical use of scientific objects and human is also treated as an object. It develops obstacles in the front of global unity and harmony. In these situations, a question has arisen on science teaching and related educational system. In present science education system, it is seen that appropriate scientific attitude according to the nature of science, does not developed in the students. No Coordination is seen between theoretical and behavioral forms of science, due to which student pass classes but do not show corresponding scientific literacy. In India, science education encourages skill development but does not develop inventions and creativity. Along with this, being exam centered makes problem in achieving success (NCF, 2005).

It is believed that due to logical nature, science is related to cognitive aspect and not related to affective aspect. So, it is good to focus on cognitive aspect rather than affective domain and affective domain could be achieved with cognitive domain. Some experts think that the development of affective domain depends upon the development of cognitive domain. So, it is not necessary to form objectives, develop teaching and conduct evaluation for affective domain. All these thoughts are good for unification of objectives but are not too relevant to make base for values and skill. So, to get more success it is necessary to see cognitive and affective aspects independently (Philip, 2009).

Present education system rejects affective domain and is focused on cognitive aspect. In traditional teaching, all the formal and informal classroom activities are assessed through achievement tests. For these tests, specification of objectives is based totally upon cognitive domain. Due to this, classroom activities are organized according to abilities of cognitive aspect and affective aspect becomes secondary and students are developed in unidirectional way. By neglecting the concept of interconnectedness of brain and heart, students are not able to actualize the study of various objects. They are not able to understand how they have to live their lives, how to dedicate themselves to the nation and how to adjust them according to the environmental and moral values (Gulati, 2006). In this way, they do not show maturity in the attainment of appropriate attitudes.

Attitudes and values relate to affective domain, are internal states of an individual that cannot be measured same as cognitive and psychomotor aspects. Affective domain was always being ignored. The emotional aspect has always been rejected and its merits have not been given proper consideration (Philip, 2009). For the development of affective domain, curricular and co-curricular activities are organized but no effective technique is used for evaluation after that. It is seen that after getting success in achievement for

the objectives of cognitive domain at a certain level, objectives of affective level are not achieved. Even, the level of classroom teaching and parallel activities is so low that it is unable in achieving higher goals of cognitive aspect. The incomplete knowledge obtained in this way does not develop desired wisdom in the context of reality and until knowledge is not translated into wisdom, the techniques of physical science will act like enemies of humanity (Rangnathnanda, 2008).

The cognitive and affective domains are the complement and do not overlap one another completely. Cognitive aspect focuses on what students learn, while the affective aspect focuses on what children learn to acquire value (Shaferd, 2008). In the context of science education, it is necessary that we move towards focusing its dependency on affective domain along with cognitive domain so it can help in solving the above problem and success could be achieved at a certain level in the field of cognitive and affective domain.

Objectives of affective domain can be achieved effectively through organizing all the activities and evaluation process of classroom on the basis of objectives of affective domain. The last three sub-objectives of the affective domain are clearly related to the identification, organization and stability of values. Therefore, it is expected that value development should be given a central place for affective development. Value based education and teaching should be encouraged for value development. The development of value based education requires the creation of such an environment in which students can display their attitudes and feelings and can develop any value in them (Bachheti, 2023). After getting value education, a learner takes decision consciously about training of values and this accountability shows through it. Teaching can be processed in both forms (art and science) to develop value based education which is not limited to merely transferring some information to the students, but through which establishment of relationships, planning and conduction may be done for the development of learning (Sood &Kavita, 2016).

All commissions and planning bodies constituted before and after independence advocated value-based teaching. Despite this, value education does not attain its appropriate level. In spite of broad acceptance of central role of values, traditional teaching does not get converted into value-based approach. Teacher forces students to accept these values like some rules without any question. In this way, values are limited as some specific responses in school system (Lim, 2007).

It is logical to go for value based education in science because many values are existed in scientific knowledge. Some social values are also founded in science along with core values of science. These values can be obtained through effective planning in science teaching on the basis of scientific and social perspectives in the subject matter of science. In this way, scientific knowledge can get a prestigious status through making

science teaching based on values, and it will be used in more effective way. Science is tightly bounded with natural values whereas technology has a strong relationship with the intellectual, aesthetic and moral values. So, it is expected that the teaching of science should be based upon values. To solve various real life problems, science teaching must necessarily include the basis of values like truth, freedom, originality, communication, unifying nature, free thinking, curiosity, objectivity, commitment, creativity etc. In science education, development of values can be done through various direct or indirect curricular and co-curricular activities and this work is possible only when the teacher is aware of the facts and has a broad perspective (Verma, 2007). In the context of value development, it is necessary for the students to make efforts to engage themselves in practical and behavioural activities related to life, so that theoretical knowledge could get practical basis and their daily life can be connected to the values. The essence of the practical approach is that the learners will get the opportunity to learn and live life according to the values of their society and humanity (Sood &Kavita, 2016). Kothari commission (1964) has also accepted the importance of science in value development and it has laid emphasis upon the development of integrated education through involvement and practice in the school system along with teaching of science (Joseph, 2014). Directors and teachers of N.C.E.R.T. have also given importance to the development of scientific attitude as a fundamental value at secondary level (Narka, 2005). The above views express the inclusion of values in science education. The value inherent in a scientific content can change the quality of that content, related applications and social reflections. Hence it is not appropriate to ignore value base in science teaching, but still, unlike other school objects, values have not been given a central place in science education.

There are so many ways to develop values through science teaching in which classroom based as well as outdoor activities may be conducted. In classroom setting, teaching must be focused on experience and thinking based approach instead of classroom-talk only so that students can be motivated to think on complex projects and dilemmatic situations when these are presented (NCF, 2005). Having seen the role and success of dilemmatic situations, for the development of moral judgment skills in students, lesson plan can be developed for science and discussion may be made on the basis of these dilemmatic situations. By interacting with such situations, learner acquires the abilities like idea formation, logic creation, and moral decision, and he is capable in taking decision after examining all the aspects related to the situation. These dilemmatic situations may be related to environmental conservation, scientific temper, social justice and equality (Sood &Kavita, 2016). For creation of such situations of value inculcation, various types of value models like thinking, logic, value analysis and value clarification etc. can be employed in classroom teaching. Any one of these model can be implicated through following some functional steps. Value clarification model has a very important

place as a major model of value development. Value clarification refers to the process of a person defining values and actions in his or her daily life (Bachheti, 2023). In this process a person can find direction in his daily life activities, and once a person gets clarity about his values, he gets out of the value dilemma and becomes clear about his desired values (Guthrie and Fritz, 2017).

Secondary education level is most appropriate stage for value education of education because it enables children to reason and think more than their previous educational stages, and a learner enables in creating meaningful knowledge regarding to new principles and laws through project or problem solving methods. By studying science at high school level, students can develop cultural, aesthetic and moral values. By studying science in correct manner, we get base to get internal meaning of different objects, correlate different facts, and to appreciate heritage provided by science to society (Osborne, 1918).

Objectives of the study:

1. To compare the effect of value-based science teaching and traditional teaching on affective domain.
2. To compare the effect of value-based science teaching and traditional teaching on cognitive domain.

Hypothesis:

1. There is no significant difference in the adjusted mean scores of post-affective achievements of students of control group and experimental group by taking pre-affective achievement and socio-emotional school climate as covariate.
2. There is no significant difference in the adjusted mean scores of post-cognitive achievements of students of control group and experimental group by taking pre-cognitive achievement and verbal intelligence as covariate.

Research Methodology

Quantitative approach was adopted for comparative study and experimental method was used for treatment and to see effect of traditional and value-based science teaching. Pre-test post-test control group design was selected for execution of experiment. Dehradun district was taken as study area and multilevel mixed approach was opted for sampling. For experimentation, two groups (experimental and control) of students of class 9 of two private secondary level schools of Uttarakhand board were made. Total 150 students were taken as sample under these created groups. Self-made tools were developed to assess cognitive and affective achievement for pre and post testing. To see the equality between groups was tested by administrating SESS, VIT, and SESCI. After ensuring the equality of groups on various parameters, pre-testing was done for cognitive and affective achievement through self-made tools of these parameters. After

pre-testing, treatment was given to both the groups. Control group was taught through traditional method while experimental group was taught science through value-based approach (value clarification model). For treatment, transcripts of lesson plan and worksheets were developed for both traditional and value-based science teaching. After executing the process of treatment for 21 days, post-test was taken for both cognitive and affective achievement. After post-testing, analysis was done for collected data according to hypothesis constructed. Post-test scores of cognitive and affective achievements of students of both groups were compared with the help of ANCOVA and for that verbal intelligence, socio-emotional school climate, cognitive achievement and affective achievement were taken as covariates.

Results and Discussion

Comparison of effect of traditional and value-based science teaching on affective achievement:

On comparing group variances for post-affective achievement using Levin's test, determined p value (0.62) founded greater than 0.05 which is shown in table 1. It means that there is no significant difference in error variances of both the groups, and both has same variances. It confirms the assumption of homogeneity.

Table 1

Levin test for comparing group variance for post-affective achievement.

Dependent Variable: Post-Affective Achievement			
F-Value	**Degree of freedom 1**	**Degree of freedom 2**	**Significance**
0.25	1	136	0.62

Table 2

One way ANCOVA to compare groups for post-affective achievement.

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Pre-Affective Achievement	22081.34	1	22081.34	32.72	0.00
Socio-Emotional School Climate	0.42	1	0.42	0.001	0.98
Treatment (Teaching Approach)	6172.05	1	6172.05	9.15	0.003
Error	90428.86	134	674.84		
Total	6769854.00	138			
Corrected Total	122296.44	137			

One way ANCOVA was used to compare the effect of treatment on post-affective achievement, through controlling socio-emotional school climate and pre-affective achievement, which is described in table 2. It is cleared from the table that for teaching

approach, adjusted F-value (9.15, df=1,134, p=0.003<0.05) is significant at 0.05 significance level. The hypothesis "There is no significant difference in the adjusted mean scores of post-affective achievement of students of control group and experimental group by taking pre-affective achievement and socio-emotional school climate as covariate" is rejected. In this way, by taking pre-affective achievement and socio-emotional school climate as covariate, adjusted mean scores of post-affective achievements of students taught through traditional and value-based science teaching are significantly different to each other.

Table 3

Adjusted mean scores for post-affective achievement.

Estimated marginal mean				
Dependent variable: Post-affective achievement				
	Mean	Standard Error	95% level of confidence	
			Lower Bound	Upper Bound
Control Group	212.73[a]	3.14	206.52	218.94
Experimental Group	226.23[a]	3.14	220.01	232.44

Adjusted mean scores for post-affective achievement of both the groups are displayed in the table 3 for estimated marginal means through controlling pre-affective achievement and socio-emotional school climate. By neutralizing the effect of covariates statistically, obtained mean scores for post-affective achievement for control and experimental groups were 212.73 and 226.23 respectively. By comparing unadjusted mean scores (211.06 for control group and 227.90 for experimental group) and adjusted mean scores, it is found that after controlling covariates, control group gained and experimental group loose partially.

It is cleared from table 3 that adjusted mean scores for post-affective achievement of students taught through traditional method and value based science teaching using value clarification model, found significantly different. It means that value based science teaching is more effective than traditional method of teaching. Study of Joseph (2014) also shows more effectiveness of value clarification model than traditional method. Along with this Anilkumar (2013) studied that at higher primary level, integrated education is effective for development of value based behaviour. Ula and Badrujaman (2021) show the significance of effect of value clarification model on values, positive interests and critical thinking of students. Although Joshi (2002) showed more effectiveness of traditional teaching than value clarification model on value identification and value judgement.

Comparison of effect of traditional and value-based science teaching on cognitive achievement:

Table 4

Levin test for comparing group variance for post-cognitive achievement.

Dependent Variable: Post-cognitive Achievement			
F-Value	Degree of freedom 1	Degree of freedom 2	Significance
3.40	1	136	0.07

On comparing group variances for post-cognitive achievement after taking covariates, determined p value (0.07) is greater than 0.05, which shows that there is no significant difference in error variances of both the groups, and both has same variances. It supports assumption of homogeneity.

Table 5

One way ANCOVA to compare groups for post-cognitive achievement.

Tests of Between-Subjects Effects						
Dependent Variable: Post-cognitive achievement						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Verbal Intelligence	17.97	1	17.97	1.37	0.24	0.01
Pre-cognitive achievement	59.01	1	59.01	4.49	0.04	0.03
Treatment	1477.60	1	1477.60	112.54	0.00	0.46
Error	1759.35	134	13.13			
Total	51872.00	138				
Corrected Total	3487.54	137				

Through controlling verbal intelligence and pre-cognitive achievement, one way ANCOVA was used to compare the effect of treatment on post-cognitive achievement of students of both groups, which is described in table 5. It is cleared from the table that adjusted F-value (112.54, df=1,134, p=0.000<0.05) for teaching approach, is significant at 0.05 significance level. So the hypothesis ”There is no significant difference in the adjusted mean scores of post-cognitive achievement of students of control group and experimental group by taking pre-cognitive achievement and verbal intelligence as covariate” is rejected. In this way, by taking pre-cognitive achievement and verbal intelligence as covariate, adjusted mean scores of post-cognitive achievement of students taught through traditional and value based science teaching, found significantly different.

Table 6

Adjusted mean scores for post-cognitive achievement.

Estimated marginal mean				
Dependent variable: Post-cognitive achievement				
	Mean	**Standard Error**	**95% level of confidence**	
			Lower Bound	**Upper Bound**
Control Group	15.42[a]	0.44	14.56	16.29
Experimental Group	22.03[a]	0.44	21.16	22.89

Adjusted mean scores for post-cognitive achievement of both the groups are displayed in the table 6 for estimated marginal means through controlling pre-cognitive achievement and verbal intelligence. By neutralizing the effect of covariates statistically, obtained mean scores for post-cognitive achievement for control and experimental groups were 15.42 and 22.03 respectively. By comparing unadjusted mean scores (15.32 for control group and 22.13 for experimental group) and adjusted mean scores, it is found that after controlling covariates, control group gained and experimental group loose partially.

It is clear from table 5 that adjusted mean scores for post-cognitive achievement of students taught through traditional method and value based science teaching using value clarification model, found significantly different. In this way the value based science teaching is more effective than traditional method of teaching. Sharma (2015) founded that the use of audio-visual aids is effective in reference to post-achievement of students in science by taking pre-achievement as covariate whereas the interactional effect of intelligence and treatment on post-achievement was not found significant. Mahesha (2014) studied that social creative model is more effective than traditional method in enhancing achievement in geography. This factor is also effective in enhancing the unity factor in a group. Siddiqui (1990) and Prakash (2009) also found the effectiveness of different models than traditional method of teaching.

Conclusion

The purpose of study was to compare the effect of value-based science teaching and traditional science teaching on cognitive and affective achievement of students. To attain this objective, intervening variables like pre-cognitive achievement, pre-affective achievement, SESCI, VIT, and SESS were tried to be controlled. It was concluded that after controlling intervening variables, mean scores of post-cognitive achievement and post-affective achievement of students taught through value-based science teaching was found more than the mean scores of post-cognitive achievement and post-affective achievement of students taught through traditional science teaching. In this way, it can be said that Value based science teaching is found more effective than traditional science

teaching.

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